Introduction

Chapter Overview

Americans are highly supportive of science and technology (S&T), but lack knowledge of them. That is the major finding of the National Science Foundation's (NSF's) biennial surveys of Public Attitudes Toward and Understanding of Science and Technology. The most recent survey in this series was conducted in early 2001.[1]

Statistics on Americans' lack of knowledge of such subjects as history, geography, mathematics, and science receive a considerable amount of media attention and are regularly cited in speeches given by various educators and policymakers. Even late night talk show hosts make fun of Americans' inability to answer simple questions. Although it is true that many Americans do not do well when quizzed on their knowledge of science and other subjects, it is not always clear how important this deficiency is. For instance, it has been noted that Americans are hardly unique; citizens in other countries perform just as poorly in tests of their basic knowledge of the world around them (Gup 2000). Also, a case can be made that most people do not need to know the answers to be able to function in their daily lives and serve as productive members of society. However, strong critical thinking and problem-solving skills—the ability to evaluate information and make sound decisions—do play an important role in people's lives.[2]

Chapter Organization

The chapter begins with a discussion of the public's interest in and knowledge of S&T. The level of interest in S&T is an indicator of both the visibility of the science and engineering (S&E) community's work and the relative importance accorded S&T by society. The first section also contains data on the level of public understanding of both basic science concepts and the scientific process.

In the second section, public attitudes toward S&T are examined. Data on public attitudes toward Federal funding of scientific research and public confidence in the science community are included. In addition, this section contains information on public perceptions of the benefits and harms (or costs) of scientific research, genetic engineering, space exploration, the use of animals in scientific research, global warming, and attitudes toward math and science education.

The next sections feature discussions on the public image of the science community, including public perceptions of scientists and science occupations, and where Americans get information about S&T. Finally, interest in science fiction and the relationship between science and pseudoscience, including concerns about belief in paranormal phenomena, are examined in the last section of the chapter.

In addition, results of surveys sponsored by organizations other than NSF are discussed throughout each section.[3]

Public Interest in and Knowledge of S&T

Most people say they are interested in S&T. When asked in a survey about their level of interest, few people will admit to having no interest. This is the usual pattern that shows up in NSF surveys in which approximately 9 out of every 10 adults interviewed by telephone report they are either very or moderately interested in new scientific discoveries and the use of new inventions and technologies. (See appendix table 7-1.)

Despite the expression of interest in S&T, few people (less than 15 percent in 2001) feel very well informed about these subjects. And, available evidence suggests that their lack of confidence in their knowledge is justified, because a substantial number of people appear to be unable to answer simple science-related questions.

In this section, four topics will be covered:

- public interest in S&T and other issues,
- the public's sense of feeling well informed about S&T and other issues,
- the "attentive" public for S&T policy, and
- public understanding of S&T.

[1]Of the 15 *Indicators* volumes published since 1972, 14 have included a chapter on public attitudes toward and understanding of S&T. The surveys for the 1972, 1974, and 1976 *Indicators* contained a block of 20 items inserted into an omnibus national personal interview survey conducted by Opinion Research Corporation of Princeton, New Jersey. The 1979 survey was designed by Miller and Prewitt (1979) and analyzed by Miller, Prewitt, and Pearson (1980); the personal interviews were conducted by the Institute for Survey Research at Temple University. Additional national surveys were undertaken for the 1982, 1985, 1987, 1991, and 1993 *Indicators* reports, with telephone interviews conducted by the Public Opinion Laboratory of Northern Illinois University. The chapter for *Science Indicators—1985* was based on a national telephone survey conducted by the Public Opinion Laboratory for Professor George Gerbner of the Annenberg School of Communication at the University of Pennsylvania. In 1995, 1997, and 1999, the Chicago Academy of Sciences conducted surveys that continued the core of attitude and knowledge items from previous *Indicators* studies and included telephone interviews with a random-digit sample of 2,006 adults in 1995, 2,000 in 1997, and 1,882 in 1999. Interviews for the 1995 survey were conducted by the Public Affairs Division of Market Facts Incorporated. The interviews for the 1997 and 1999 surveys were conducted by the National Opinion Research Center. The 2001 survey was conducted by ORC Macro and included telephone interviews with a random-digit sample of adults. The results can be found in past volumes of *Indicators*.

In general, the response rate for previous NSF surveys has been 70 percent or higher. However, for the 1999 and 2001 surveys, the response rates were 66 and 39 percent, respectively. Moreover, the highly educated were overrepresented in the 2001 survey, and those with little education, underrepresented. For more information on the 1999 survey methodology, see Miller, Kimmel, and Hess (2000), and for more information on the 2001 survey, see Duffy, Muzzy, and Robb (2001).

[2]In a recent survey, workers rated critical thinking skills as more important than job-specific skills such as computer skills (Hebel 2000).

[3]Every effort was made to include relevant data from sources other than NSF. However, it should be noted that not many survey organizations regularly or even occasionally collect information on public attitudes toward or understanding of S&T.

Public Interest in S&T and Other Issues

Surveys conducted by NSF and other organizations consistently show that Americans are interested in S&T issues. Among those who participated in the 2001 NSF survey, 47 percent said that they were *very interested* in new scientific discoveries, and 43 percent reported that they were *very interested* in the use of new inventions and technologies. About 45 percent said that they were *moderately interested* in these issues, and about 10 percent reported *no interest*. (See appendix table 7-1 and figure 7-1.)

Nearly everyone is interested in new medical discoveries. Year after year, more people express interest in this subject than in any other. In 2001, about two-thirds of the NSF survey respondents reported they were *very interested* in new medical discoveries.[4] None of the other survey items, except local school issues, received such a high percentage of *very interested* responses. Local school issues ranked second, with 59 percent of the respondents saying they were *very interested* in this topic. (See appendix table 7-1.)

In 2001, the level of interest in S&T came close to an all-time high. On a scale ranging from 0 to 100,[5] the average level of public interest in new scientific discoveries was 69. Between 1985 and 1995, the index scores for this item ranged from 61 in 1992 to 67 in 1995. (See figure 7-2 and appendix table 7-2.)

The interest index for new inventions and technologies tracks quite closely with that for new scientific discoveries. It has been no lower than 64 since 1983. In 2001, the index level for this item was 66. The highest score ever recorded for this item was 69 in 1997. (See figure 7-2 and appendix table 7-2.)

New medical discoveries is the only issue that has consistently produced interest index scores in the 80s. Scores for environmental pollution and local school issues have been in the 70s for the past 10 years. Interest in environmental pollution seems to have gradually subsided, dropping from 80 in 1990 to 70 only 11 years later. During the same period, interest in local school issues increased from 67 in 1990 to 74 in 2001. Despite all the newsworthy events taking place in space during the past few years, interest in space exploration declined, dropping from 55 in 1997 to 50 in 2001. (See "Public Attitudes Toward Space Exploration.")

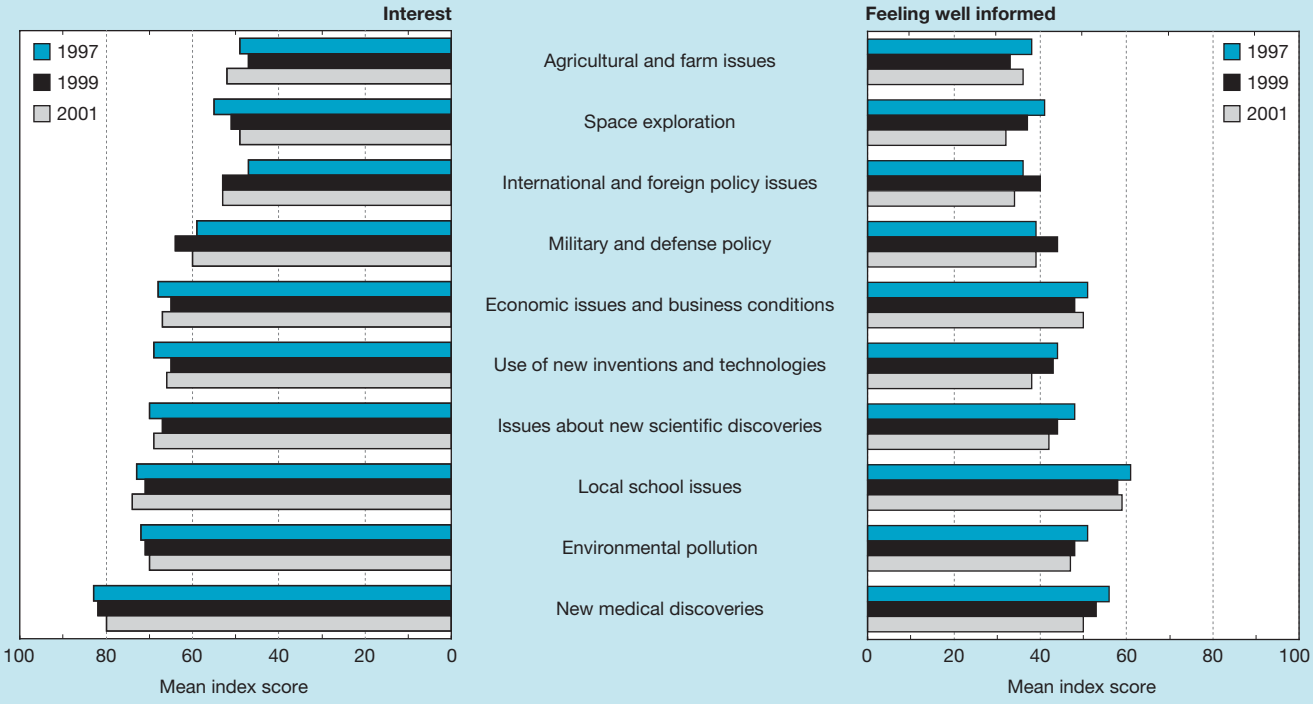
Are People as Interested in S&T Issues as They Assert?

When asked about their interest in S&T issues, few survey respondents admit being uninterested. However, there is reason to believe that their level of interest may not be as high as the data indicate. Surveys conducted by the Pew Research Center show crime, health, sports, and community affairs as the four types of news followed most closely by the

[4]Americans not only are interested in new medical discoveries, but also strongly support government-sponsored medical research. In a Research!America (2000) poll, 65 percent of those surveyed said they supported doubling spending on such research during the next five years.

[5]Responses were converted to index scores ranging from 0 to 100 by assigning a value of 100 for a "very interested" response, a value of 50 for a "moderately interested" response, and a value of 0 for a "not at all interested" response. The values for each issue were then averaged to produce an index score reflecting the average level of interest for the given issue.

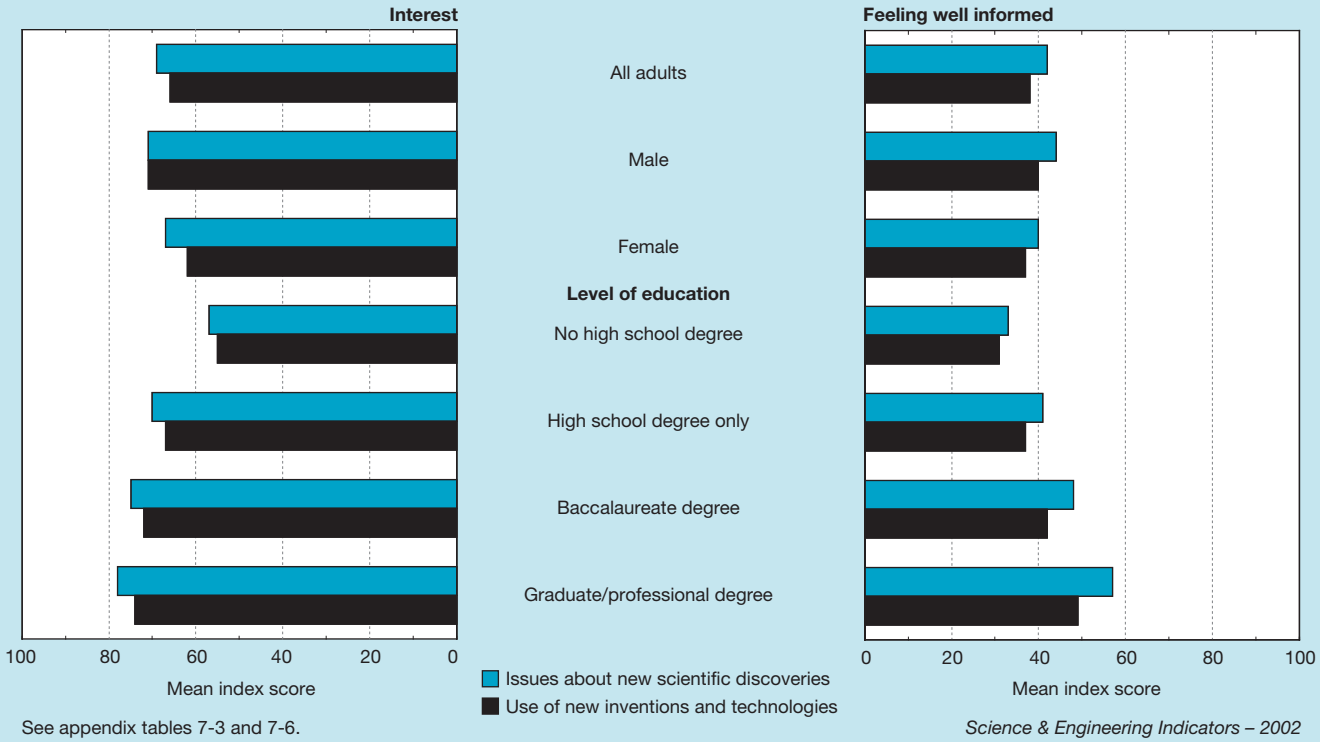
Figure 7-1.
Indices of public interest in and feeling well informed about public policy issues: 1997, 1999, and 2001



See appendix tables 7-2 and 7-5.

Science & Engineering Indicators – 2002

Figure 7-2.
Indices of public interest in and feeling well informed about scientific and technological issues, by sex and level of education: 2001



See appendix tables 7-3 and 7-6.

Science & Engineering Indicators – 2002

American public; S&T ranks only seventh. (See text table 7-1 and sidebar "Leading News Stories of 2000.") Still, interest in news about S&T is only part of the story. The millions of people who visit science museums every year are also demonstrating interest in science without necessarily being interested in science news. (See "Where Americans Get Information About Science and Technology.") In addition, the number of science-related books on best seller lists seems to be increasing (Lewenstein 2001).[6]

In addition, S&T issues are rarely selected in most national polls designed to determine the top public priorities in the United States. For example, according to one recent poll from 2000, the leading public priorities are (1) improving the educational system, (2) keeping the economy strong, (3) securing Social Security, (4) reducing crime, and (5) securing Medicare (Pew Research Center for the People and the Press 2000a). In the same poll, protecting the environment ranked ninth, just ahead of national defense. Science did not rank among the top 14. However, when survey participants are specifically given the opportunity to rank S&T in the context of other issues, their priorities can change. In such a poll, 50 percent of those surveyed said that "more money for science

[6]The first science-related books on the *Publishers Weekly* best seller list to sell more than a half million copies were Carl Sagan's *Cosmos* in 1980 and Stephen Hawking's *Brief History of Time* in 1988. The success of *Cosmos* led to Sagan receiving a $2 million advance for his science fiction novel *Contact*, the largest advance up until that time for a work of fiction that had yet to be written (Lewenstein 2001).

Text table 7-1.
News followed by American public: 2000

Type of news	Percentage following very closely		
	All	Internet users	Non-Internet users
Crime	30	25	35
Health	29	26	31
Sports	27	28	25
Community	26	22	30
Religion	21	17	27
Local government	20	19	22
Science and technology	18	22	14
Washington news	17	17	17
Entertainment	14	14	17
International affairs	14	15	14
Business and finance	14	17	10
Consumer news	12	13	11
Culture and arts	10	11	8

NOTE: Responses are to the following question: Please tell me how closely you follow this type of news either in the newspaper, on television, or on radio: very closely, somewhat closely, not very closely, or not at all closely?

SOURCE: Pew Research Center for the People and the Press, "Internet Sapping Broadcast News Audience: Investors Now Go Online for Quotes, Advice," Biennial Media Consumption survey (Washington, DC, June 11, 2000). Available at <http://www.people-press.org/media00rpt.htm>.

Science & Engineering Indicators – 2002

research and engineering" was *very important*, and 44 percent said *somewhat important,* ranking this issue ahead of tax cuts (50 and 35 percent, respectively) and campaign finance reform (29 and 36 percent, respectively) (Research! America 2001). As in many other polls, however, education and Social Security/Medicare were ranked ahead of every other issue in terms of importance, with 85 and 72 percent, respectively, of those surveyed saying those two public agenda items were *very important*.

Most polls, especially those conducted during the 2000 presidential campaign, show education to be one of the public's top priorities (Gallup Poll Editors 2001). Thus, it is not surprising to see the NSF interest index score for local school issues jumping three points between 1999 and 2001 from 71 to 74, displacing environmental pollution as the public's second highest priority (after new medical discoveries).

Sex as an Indicator of Interest in S&T Issues

Men express more interest than women in new scientific discoveries and the use of new inventions and technologies. (See figure 7-2.) The 9-point gap is particularly large for the latter but smaller than the 14-point gap for space exploration. Men also express more interest than women in economic and business conditions, military and defense policy, and international and foreign policy. Women are more interested than men in new medical discoveries and local school issues; the differences are 11 and 10 points, respectively. (See appendix table 7-3.)

Level of Education as an Indicator of Interest in S&T Issues

Level of formal education and number of mathematics and science courses completed are associated with interest in new scientific discoveries and the use of new inventions and technologies. (See figure 7-2 and appendix table 7-3.) A relationship also exists between education and level of interest in international and foreign policy, space exploration, and economic issues and business conditions. There does not seem to be a relationship between education and level of interest in new medical discoveries, military and defense policy, or environmental pollution. (See appendix table 7-3.)

In addition, people who have college degrees follow S&T stories more closely than those who do not. For example, in the July 2000 Pew Research Center survey, 25 percent of those who had college degrees said they were closely following the human genome announcement. Among those who did not have college degrees, fewer than 12 percent were closely following the story. In contrast, during the same month, 23 percent of the latter group said they were closely following the story about the Philadelphia police beating a carjacking suspect. Only 16 percent of those who had college degrees claimed to be following that story very closely (Pew Research Center for the People and the Press 2000c).

Data for the United Kingdom

Although comparable data for the European Union, Japan, and Canada have not been collected since the late 1980s or early 1990s (these data were included in previous editions of *Indicators*), several items used in the U.S. survey were replicated in a 2000 survey of U.K. residents (Office of Science and Technology and The Wellcome Trust 2000). The data show that British residents express less interest than their counter-

Leading News Stories of 2000

Few science or technology stories attract much public interest. According to the Pew Research Center's surveys, which track public interest in specific domestic and international news stories, the leading science-related news story of 2000 was the announcement that scientists had completed mapping the human genome (Pew Research Center for the People and the Press 2000c). However, only 16 percent of those interviewed reported that they were following this story very closely. In contrast, 61 percent said they were closely following the recent increase in gas prices, putting that issue at the top of the list of leading news stories of 2000, followed by the terrorist attack on the USS Cole, at 44 percent.* Rounding out the top 10, at number 10, was the Super Bowl; 31 percent of those surveyed reported they were closely following that story, nearly twice as many as the number who said they were closely following the human genome story.

The Federal court ruling ordering the breakup of Microsoft (since overturned) attracted almost as much interest as the Super Bowl story; 28 percent said they were closely following the Microsoft story.† However, this news may have been more of a business story than a technology story, although a case can be made that the court decision will have a major effect on innovation in the software industry. The Microsoft case spotlights an issue that has long been a fertile subject for study and debate among economists, which is the effect of antitrust policy on innovation.

Death and/or destruction usually lead Pew's list of the top 10 stories each year (although 2000 was somewhat of an exception). In fact, most of the science-related stories on the list of the most closely followed stories of the past 15 years are about natural disasters, e.g., earthquakes, floods, and other weather-related stories. Only about 2 percent of the 776 stories on the list are about scientific breakthroughs, research, and exploration (Pew Research Center for the People and the Press 2000d).

*Although the increase in gas prices received less press coverage than the election, this story hits closer to home for most people. This is the highest recorded interest in gas prices since the Persian Gulf War in 1990.

†According to a Gallup poll, although about half the public believes Microsoft is a monopoly, most people do not think the company should be broken up (Moore 2001).

parts in the United States in new medical discoveries, environmental issues, new inventions and technologies, and new scientific discoveries. (See text table 7-2.)

In addition, U.K. survey participants were asked to rate (on a 5-point scale) their interest in, and to assess the benefits of, 11 disciplines or technologies. Rankings by level of interest and perceived benefits were similar. For example: Two health-related items, new medicines and heart and other transplants, were at the top of both lists: 35 and 28 percent, respectively, of the respondents said they were *very interested* in these topics. Respondents were also most likely to judge these items as beneficial; 61 and 56 percent, respectively, categorized them as *very beneficial*.

Ranking next in terms of both interest and perceived benefits were research into climate change as well as computing and the Internet (both with 20 percent *very interested* and 29 percent *very beneficial* responses). Respondents also saw telecommunications as being highly beneficial. In addition to the 28 percent who judged these technologies as being very beneficial, another 52 percent gave this item a "4" on the 5-point scale, placing it just behind new medicines and heart and other transplants in terms of the total percentage scoring this category beneficial. However, only 16 percent of the respondents said they were very interested in telecommunications. New and faster methods of transportation rounded out the top six categories.

Five items received the lowest scores under both criteria. In order of perceived benefits were human fertility testing, new methods of food production and manufacture, space research and astronomy, genetic testing, and cloning. Respondents expressed more interest, however, in space and food than in the other biology-related categories.

The Public's Sense of Being Well Informed about S&T Issues

In general, most Americans feel that they are not well informed about S&T issues. In fact, for all issues included in the 2001 NSF survey, the level of feeling well informed was considerably lower than the level of expressed interest. For example, in the 2001 NSF survey, nearly half of the respondents said they were *very interested* in new developments in science and technology. Yet fewer than 15 percent of respondents described themselves as *very well informed* about new scientific discoveries and the use of new inventions and technologies; approximately 30 percent considered themselves *poorly informed*. (See appendix table 7-4.) Consequently, the corresponding index scores[7] were lower than the interest index scores for those same issues. (See figure 7-1.)

In 2001, three issues exhibited index scores in the 50s (local school issues, economic issues and business conditions, and new medical discoveries); two exhibited scores in the 40s (environmental pollution and issues about new scientific discoveries); and the other five exhibited scores in the 30s. (See appendix table 7-5.)

The NSF survey shows that people are feeling less informed than they used to. This downward trend is particularly noticeable for the five S&T-related issues included in the survey: between 1997 and 2001, index scores fell 5 or more points for four issues (new medical discoveries, new scientific discoveries, the use of new inventions and technologies, and space exploration) and 4 points for environmental pollution.

Sex as an Indicator of Feeling Well Informed About S&T Issues

Men were more likely than women to feel well informed about 6 of the 10 issues included in the 2001 NSF survey. By far the widest gap, 13 points, was in space exploration. Military and defense policy and economic issues and business conditions had gender gaps of 10 and 9 points, respectively. Other items (for example, issues about new scientific discoveries and international and foreign policy issues) had gender gaps of 7 or fewer points. (See appendix table 7-6.)

[7]Responses were converted to index scores ranging from 0 to 100 by assigning a value of 100 for a "very well informed" response, a value of 50 for a "moderately well informed" response, and a value of 0 for a "poorly informed" response. The values for each issue were then averaged to produce an index score reflecting the average level of feeling informed for the given issue.

Text table 7-2.
Interest in science-related topical issues, United States and United Kingdom: 2000/2001
(Percent)

	Very interested		Moderately interested		Not interested	
Issue	U.S.	U.K.	U.S.	U.K.	U.S.	U.K.
New medical discoveries	66	46	31	41	3	13
Environmental issues	50	35	43	47	7	17
New inventions and technologies	46	24	46	50	8	26
New scientific discoveries	50	22	45	49	6	28

NOTES: Data for United States collected in 2001; data for United Kingdom collected in 2000.

SOURCES: National Science Foundation, 2001 Survey of Public Attitudes Toward and Understanding of Science and Technology (Arlington, VA, 2001); Office of Science and Technology and The Wellcome Trust, "Science and the Public: A Review of Science Communication in the United Kingdom" (London, UK, March 2000).

In contrast, women were more likely than men to feel well informed about two issues in the survey: local school issues and new medical discoveries. For these issues, the disparity in index scores between the two sexes was 10 and 7 points, respectively.

Level of Education as an Indicator of Feeling Well Informed About S&T Issues

As expected, in general, the more education an individual has, and the more mathematics and science courses the individual has completed, the better informed that person believes he or she is. The relationship between education and feeling well informed is evident for new scientific discoveries, the use of new inventions and technologies, space exploration, economic issues and business conditions, and international and foreign policy issues, but not for the other issues in the survey. (See appendix table 7-6.)

The "Attentive Public" for S&T Issues

It may not be easy to pinpoint exactly the audience for issues pertaining to S&T policy. It is probably safe to say that members of the S&E workforce, especially those in the academic community, are interested in and well informed about various S&T policy issues. However, the number of members in this community is relatively small. (See chapter 3, "Science and Engineering Workforce," and chapter 5, "Academic Research and Development.")

In addition to scientists and engineers and those who work in science policy, other members of the public are interested in S&T and probably pay attention to news reports about new scientific discoveries and new inventions and technologies. Also, some people are attentive because a particular S&T-related issue or event is affecting their daily lives. This type of situation was portrayed in the popular movie *Erin Brockovich,* in which the main character, who was not a scientist or even well educated, embarked on a mission to learn everything she could about a scientific issue that was at the center of a court case. Although the science community took umbrage at the way scientific evidence was portrayed in the film (Kolata 2000), the movie illustrates how people become informed and attentive when their health and well-being are at stake.

Classifying the Public as Attentive, Interested, or Residual

It is important to identify the audience for S&T issues so that the attitudes of this group can be compared with those of everyone else. Therefore, it is useful to classify the public into three groups:

- The *attentive public* consists of those who (1) express a high level of interest in a particular issue; (2) feel very well informed about the issue; and (3) read a newspaper on a daily basis, read a weekly or monthly news magazine, or read a magazine relevant to the issue.[8]
- The *interested public* consists of those who claim to have a high level of interest in a particular issue but do not feel very well informed about it.
- The *residual public* consists of those who are neither interested in nor feel very well informed about a particular issue.

Given these criteria, there is an attentive public for every policy issue. The corresponding groups differ in size and composition. For example, data for 2001 showed that, for most issues covered by the NSF survey, fewer than 10 percent of the public could be considered attentive. Local school issues had, by far, the largest audience, followed by new medical discoveries, economic and business conditions, and environmental pollution. In 2001, 31, 14, 12, and 10 percent, respectively, of all survey respondents were classified as attentive to those subjects. (See appendix table 7-7.)

Identifying the Attentive Public for S&T Issues

People likely to be attentive to S&T issues are identified by combining the attentive public for new scientific discoveries with the attentive public for new inventions and technologies. In 2001, 10 percent of the population met the criteria, down from 14 percent in 1997. In 2001, 48 percent of the population could be classified as the interested public for S&T issues; the residual public constituted 42 percent of the total. (See appendix table 7-7.)

Sex and Level of Education as Identifiers of the Attentive Public for S&T Issues

Men were more likely than women to be attentive to S&T issues. (See figure 7-3 and appendix table 7-8.) In addition, a direct correlation exists between attentiveness to S&T issues, years of formal education, and the number of science and mathematics courses completed during high school and college. In 2001, only 3 percent of people lacking high school diplomas were classified as attentive to S&T issues, compared with 23 percent of those who had graduate and/or professional degrees. Similarly, 7 percent of those having limited coursework in science and mathematics were attentive to S&T issues compared with 18 percent of those who had completed nine or more high school and college courses in science or mathematics.

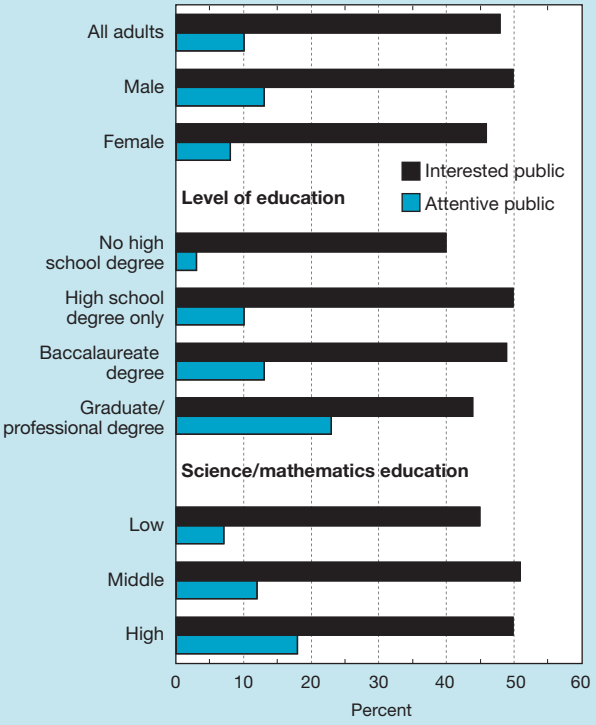
Public Understanding of S&T

Science literacy in the United States is fairly low.[9] The majority of the general public knows a little, but not a lot, about S&T. For example, most Americans know that Earth travels around the Sun and that light travels faster than sound. However, few can successfully define *molecule*. In addition, most Americans are unfamiliar with the scientific process.

[8]For a general discussion of the concept of issue attentiveness, see Miller, Pardo, and Niwa (1997).

[9]It is useful to draw a distinction between *science literacy* and *scientific literacy*. Science literacy refers to the possession of technical knowledge. In contrast, scientific literacy involves not simply knowing the facts but also thinking logically, drawing conclusions, and making decisions based on careful scrutiny and analysis of the facts (Maienschein 1999).

Figure 7-3.
Public attentiveness to science and technology issues, by sex and level of education: 2001



NOTES: "Attentive" public are people who (1) express high level of interest in a particular issue; (2) feel well informed about that issue, and (3) read a newspaper on a daily basis, read a weekly or monthly news magazine, or frequently read a magazine highly relevant to the issue. "Interested" public are people who express high level of interest in a particular issue but do not feel well informed about it. The attentive public for science and technology is a combination of the attentive public for new scientific discoveries and the attentive public for new inventions and technologies. Anyone who is not attentive to either of these issues, but who is a member of the interested public for at least one of these issues, is classified as a member of the interested public for science and technology. Survey respondents were classified as having a "high" level of science/mathematics education if they took nine or more high school and college math/science courses. They were classified as "middle" if they took six to eight such courses, and "low" if they took five or fewer.

See appendix table 7-8. *Science & Engineering Indicators – 2002*

People who have knowledge of basic science facts, concepts, and vocabulary may have an easier time following news reports and participating in public discourse on various issues pertaining to S&T. Even more important than having basic knowledge may be an appreciation for the nature of scientific inquiry. Understanding how ideas are investigated and analyzed can be valuable for staying abreast of important issues, participating in the political process, and assessing the validity of other types of information. (See "Science Fiction and Pseudoscience.") According to a science journalist:

> Without a grasp of scientific ways of thinking, the average person cannot tell the difference between science based on real data and something that resembles science—at least in their eyes—but is based on uncontrolled experiments, anecdotal evidence, and passionate assertions…[W]hat makes science special is that evidence has to meet certain standards (Rensberger 2000, p. 61).

The NSF survey contains a series of questions designed to assess public knowledge and understanding of basic science concepts and terms. The survey includes 18 such questions: 13 true or false, 3 multiple choice, and 2 open-ended questions that asked respondents to define in their own words *DNA* and *molecule*. In addition, the survey includes questions designed to test public understanding of the scientific process, including knowledge of what it means to study something scientifically, how experiments are conducted, and probability.

Understanding Science Facts, Concepts, and Vocabulary

The percentage of correct responses to most of the NSF survey questions pertaining to basic science facts, concepts, and vocabulary has remained nearly constant. (See appendix table 7-9.) For example, more than 70 percent of those surveyed knew that:

- Plants produce oxygen.
- The continents have been moving for millions of years and will continue to move.
- Light travels faster than sound.
- Earth goes around the Sun (and not vice versa).
- Not all radioactivity is manmade.

In contrast, about half the respondents knew that:

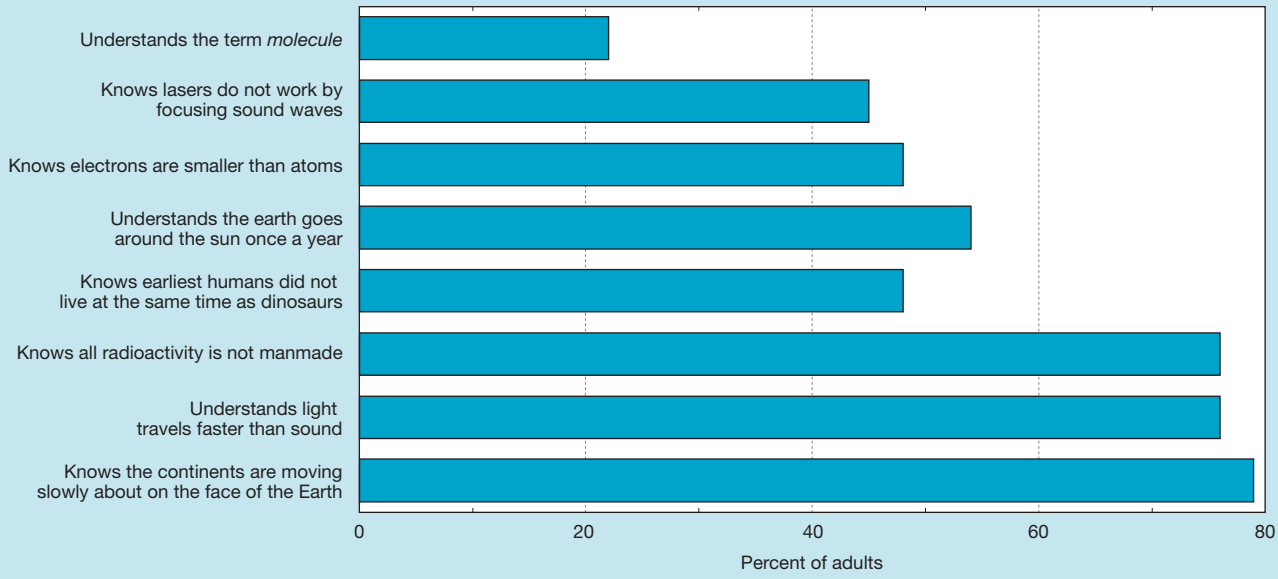
- The earliest humans did not live at the same time as dinosaurs.
- It takes Earth one year to go around the Sun.
- Electrons are smaller than atoms.
- Antibiotics do not kill viruses.
- Lasers do not work by focusing sound waves. (See figure 7-4 and appendix table 7-10.)

A strong, positive relationship exists between number of correctly answered questions and level of formal education, number of science and mathematics courses completed, and attentiveness to S&T. For example, those who did not complete high school answered an average of 50 percent of the questions correctly compared with scores of 63 percent for high school graduates, 77 percent for college graduates, and 80 percent for those who earned graduate or professional degrees. (See appendix table 7-9.)

In addition, only 22 percent of respondents were able to define *molecule*, and 45 percent gave an acceptable definition for *DNA*.[10] Although the percentage of correct responses

[10]These percentages are higher than those recorded in past NSF surveys. The increase may be attributable to a different technology being used to record responses to open-ended questions. For the first time, in 2001, respondents' answers were recorded on audiotape instead of being manually typed into a computer by the interviewer. Thus, the coders worked from sound files of actual responses rather than hand-typed text. Probably as a result of having more complete information from each respondent, more respondents were classified as having provided an acceptable definition of these terms. See Miller and Kimmel (2001) and Duffy, Muzzy, and Robb (2001).

Figure 7-4.
Public understanding of scientific terms and concepts: 2001



See appendix table 7-10.

Science & Engineering Indicators – 2002

to these questions was considerably lower than that for most of the short-answer questions, it is noteworthy that the percentage of correct responses increased in the late 1990s.

A higher percentage of men than women answered every question but three correctly. The gender gap was 20 or more points for four questions:

- Lasers work by focusing sound waves (61 percent of men compared with 30 percent of women).
- Light travels faster than sound (89 percent of men compared with 65 percent of women).
- Earth takes one year to go around the Sun (66 percent of men compared with 42 percent of women).
- Earth goes around the Sun and not vice versa (86 percent of men compared with 66 percent of women).

More women than men answered the following questions correctly:

- The father's gene decides whether the baby is a boy or a girl (72 percent of women compared with 58 percent of men).
- Antibiotics do not kill viruses (55 percent of women compared with 46 percent of men).

For the first time, a majority of all survey respondents answered the antibiotic question correctly (although a majority of men missed it). The growing resistance of bacteria to antibiotics has received widespread media coverage during the past few years. In identifying the main cause of the problem, the overprescribing of antibiotics, it is almost always mentioned that antibiotics are ineffective in killing viruses. In addition, parents of young children, especially those prone to ear infections, have been warned by their pediatricians about this problem. Although the message still has not reached a large segment of the population, the percentage of those answering correctly has been rising, from 40 percent in 1995 to 51 percent in 2001.

During most of the 20th century, probably the most contentious issue in science teaching has been whether evolution is taught or not taught in U.S. public school classrooms. The latest major dispute in this long-running battle was the Kansas State Board of Education's 1999 decision to delete evolution from the state's science standards. This event received widespread coverage in the press and sparked an outcry in the science community.[11] In addition, most of the public was not happy with the decision; 60 percent of Americans were opposed to the school board's action.[12] Moreover, most Kansans also felt the same way.[13] Thus, it was not too surprising when two board members who had voted for the change were defeated in the next election by candidates who supported the teaching of evolution. Subsequently, the reconstituted Kansas School Board reversed the decision.

The attention received by the Kansas controversy may be responsible for a change in response to the "evolution" question. For the first time, a majority of survey respondents an-

[11]The National Science Board issued a statement in August 1999 on the Kansas action (NSB 1999).

[12]According to the results of this survey (People for the American Way Foundation 2000), opponents of the school board action were more likely to be better educated, younger, and residents of the Northeast.

[13]In an October 1999 poll, sponsored by the *Kansas City Star* and the *Wichita Eagle* (1999), 52 percent of the participants disagreed with the Kansas State Board of Education's decision; 57 percent agreed with the statement: "Students in science classes in public schools should study and be tested on the idea of evolution, the theory that living creatures have common ancestors and have changed over time."

swered *true* to the statement "human beings, as we know them today, developed from earlier species of animals," representing a major change in response to this question[14] and bringing the United States more in line with other industrialized countries in response to this question (Gendall, Smith, and Russell 1995).

Gallup polls taken during the past 20 years consistently show a plurality (45 percent in February 2001) of Americans agreeing with the statement: "God created human beings pretty much in their present form at one time within the last 10,000 years or so" (Brooks 2001).

In addition, two-thirds of those surveyed (68 percent) favor teaching this belief (known as creationism) along with evolution in public schools, although 29 percent are opposed. However, 55 percent are opposed to teaching creationism *instead* of evolution (*Gallup News Service* 2000).

A study conducted for the People for the American Way Foundation took a closer look at the question of teaching evolution and found an overwhelming majority of Americans (83 percent) agreeing that it should be taught in the classroom. However, there is also strong support for teaching creationism. A detailed breakdown of the survey findings shows a wide range of opinion on the issue:

- 20 percent favor teaching only evolution and nothing else in public schools;
- 17 percent want only evolution taught in science classes but say that religious explanations can be discussed in other classes;
- 29 percent do not have a problem with creationism being discussed in science classes but believe it should be discussed as a "belief," not a scientific theory;
- 13 percent believe that both evolution and creationism should be taught as scientific theories in science class;
- 16 percent want no mention of evolution at all;
- 4 percent are in favor of teaching both evolution and creationism but are unsure about how to do it; and
- 1 percent have no opinion (People for American Way Foundation 2000).

Understanding the Scientific Process

The NSF survey also includes questions intended to determine how well the public understands the scientific process. Respondents are asked to explain what it means to study something scientifically.[15] In addition, respondents are asked questions pertaining to the experimental evaluation of a drug and about probability.[16]

In 2001, 33 percent of respondents provided good explanations of what it means to study something scientifically.[17] A large minority (43 percent) answered the experiment questions correctly, including the question(s) that focused on the use of control groups. A majority (57 percent) answered the four probability questions correctly. (See appendix table 7-11.)

A combination of each survey participant's responses to the three items is used to estimate his or her overall level of understanding of the scientific process. To be classified as "understanding the scientific process," a respondent must answer all the probability questions correctly and either provide a "theory testing" response to the question about what it means to study something scientifically or provide a correct response to the open-ended question by explaining why it is better to test a drug using a control group. In 2001, 30 percent of respondents met these criteria. (See footnote 10, figure 7-5, and appendix table 7-11.)

Public Attitudes Toward S&T, Scientific Research, Federal Funding of Scientific Research, and Specific Science-Related Issues

In general, Americans express highly favorable attitudes toward S&T. In 2001, overwhelming majorities of NSF survey respondents agreed with the following statements:

- "Science and technology are making our lives healthier, easier, and more comfortable." (86 percent agreed and 11 percent disagreed)
- "Most scientists want to work on things that will make life better for the average person." (89 percent agreed and 9 percent disagreed)
- "With the application of science and technology, work will become more interesting." (72 percent agreed and 23 percent disagreed)
- "Because of science and technology, there will be more opportunities for the next generation." (85 percent agreed and 14 percent disagreed) (See appendix table 7-12.)

[14]For example, the comparable percentages for 1985, 1990, 1995, and 1999 were 45, 45, 44, and 45 percent, respectively.

[15] The question was: "When you read news stories, you see certain sets of words and terms. We are interested in how many people recognize certain kinds of terms, and I would like to ask you a few brief questions in that regard. First, some articles refer to the results of a scientific study. When you read or hear the term scientific study, do you have a clear understanding of what it means, a general sense of what it means, or little understanding of what it means?" If the response is "clear understanding" or "general sense": "In your own words, could you tell me what it means to study something scientifically?"

[16]The question pertaining to experimental evaluation was: "Now, please think of this situation. Two scientists want to know if a certain drug is effective in treating high blood pressure. The first scientist wants to give the drug to 1,000 people with high blood pressure and see how many experience lower blood pressure levels. The second scientist wants to give the drug to 500 people with high blood pressure, and not give the drug to another 500 people with high blood pressure, and see how many in both groups experience lower blood pressure levels. Which is the better way to test this drug? Why is it better to test the drug this way?" The text of the probability question was: "Now think about this situation. A doctor tells a couple that their 'genetic makeup' means that they've got one in four chances of having a child with an inherited illness. Does this mean that if their first three children are healthy, the fourth will have the illness? Does this mean that if their first child has the illness, the next three will not? Does this mean that each of the couple's children will have the same risk of suffering from the illness? Does this mean that if they have only three children, none will have the illness?"

[17]Correct explanations of scientific study include responses describing scientific study as theory testing, experimentation, or rigorous, systematic comparison.